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6220 CULEBRA RD. 78238-5166 • P.O. DRAWER 28510 78228-0510 • SAN ANTONIO, TEXAS, USA • (210) 684-5111 • WWW.SWRI.ORG
ENGINE, EMISSIONS AND VEHICLE RESEARCH DIVISION
FAX: (210) 522-3950

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July 18, 2008

To: Environmental Protection Agency
Cincinnati Procurement Operations Division
26 West Martin Luther King Drive
Cincinnati, OH 45268

Attention: Ms. Tammy Thomas
Contract Officer

From: Kevin Whitney
Emissions Research and Development Department
Southwest Research Institute
P.O. Drawer 28510
San Antonio, Texas 78228-0510

Subject: Work Plan for Work Assignment 1-02, EPA Contract EP-C-07-028, under SwRI Project 03.14175, SwRI Proposal No. 03-53263.

Contract Title: "Testing and Related Support for Energy Bill-Mandated Activities"

Assignment Title: "Comprehensive Gasoline Light Duty Exhaust Fuel Effects Test Program to Cover Multiple Fuel Properties and Two Ambient Test Temperatures"

1.0 INTRODUCTION

Section 1506 of the Energy Policy Act of 2005 (Energy Act) requires EPA to produce an updated fuel effects model representing the 2007 light duty gasoline fleet, including determination of the emissions impacts of increased renewable fuel use.

The use of ethanol in gasoline has increased more than five-fold since 2000, and it is likely that its use will continue to expand into the next decade. It is also likely that use of high-level blends such as E85 will expand significantly.

Additionally, recent investigation related to the Mobile Source Air Toxics (MSAT2) rulemaking has shown that hydrocarbon emissions from light duty gasoline vehicles increase significantly as test temperature is decreased. As a result, the MSAT2 rulemaking promulgated NMHC standards at 20°F. However, this being a relatively new area of study, fuel effects data at temperatures lower than 75°F is scarce for use in emissions models.

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Hydrocarbon (HC) emissions are composed of hundreds of compounds, some of which have been identified by the EPA as air toxics. The Clean Air Act directs EPA to set standards to reduce air toxics emissions. Most existing data on the fractional relationship between the various air toxics and HC emissions has been established using vehicles meeting Tier 0 emissions standards (now more than 10 years old), and burning fuels that did not contain ethanol.

In order to help EPA develop a better understanding of the impact of ethanol fuel blends on light duty vehicle emissions, Southwest Research Institute® (SwRI®) will conduct Work Assignment 1-02, "Comprehensive Gasoline Light Duty Exhaust Fuel Effects Test Program to Cover Multiple Fuel Properties and Two Ambient Test Temperatures". SwRI will comply with the requirements of Work Assignment 1-02 as described in the EPA Statement of Work.

2.0 OBJECTIVES

The objective of Work Assignment (WA) 1-02 is to fill significant data gaps on fuel effects for the newest-technology (Tier 2) vehicles follows:

- Multiple levels of ethanol in gasoline will be examined in this test program, along with ethanol's interactions with other fuel properties such as volatility and distillation parameters.
- Varying levels of aromatics will also be evaluated, as they continue to be of interest due to their relationship to emissions of air toxics and the formation of particulate matter in the atmosphere.
- Tests will be performed at 50°F to fill the gap in the existing data at reduced ambient temperatures.
- Total hydrocarbon (THC), non-methane hydrocarbons (NMHC), non-methane organic gas (NMOG), oxides of nitrogen (NO_X), nitrogen dioxide (NO_2), carbon monoxide (CO), carbon dioxide (CO_2), particulate matter (PM), nitrous oxide (N_2O), ammonia (NH_3) and hydrogen cyanide (HCN) emissions shall be measured in newer (Tier 2) vehicles.
- This program will also generate speciated volatile organic compound (speciated VOC) data. VOC compounds of interest include C_1 – C_{12} hydrocarbons as well as light alcohols and carbonyls.

This is a follow-on WA to complete work described under Phase 2 of WA 0-01.

3.0 SCOPE OF WORK

This work assignment requires SwRI to test 19 test vehicles using 3 fuels. The vehicles and fuels have been procured under WAs 0-01 and 1-04. SwRI will also provide engineering, technical, and quality assurance support for this project. Engineering support includes facility design, test plan development, and general oversight of data collection activities. Technical support includes installing and maintaining all instrumentation and support equipment, as well as calibration, testing, and data processing activities. Quality assurance support includes reviewing existing standard operating procedures, preparing quality-related documentation, developing miscellaneous operating

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procedures as needed, and reviewing raw and processed data prior to delivery to EPA. Details of the project are presented below.

3.1 Work Plan Development

This document represents the current Work Plan.

3.2 Quality Assurance Project Plan and Quality Management Plan (QAPP/QMP)

The Quality Assurance Project Plan submitted for WA 0-01 will remain in effect for the Work Assignment. It will be modified as necessary for this WA.

3.3 Vehicle Recruitment

SwRI is currently leasing 19 test vehicles as described in Table 1. These vehicles were procured under WA 0-01, and will be retained for additional testing under WA 1-02 and future anticipated WAs. The budget for this WA includes the cost of vehicle leasing only during the performance of the work described herein, which is anticipated to take approximately four months.

TABLE 1. TEST VEHICLES FOR RECRUITMENT

MAKE	YEAR	BRAND	MODEL	ENGINE	FAMILY	T2 BIN	NOTE
GM	2008	Chevrolet	Cobalt	2.4L I4	8GMXV02.4025	5	
GM	2008	Chevrolet	Impala	3.5L V6	8GMXV03.9052	5	FFV
GM	2008	Saturn	Outlook	3.6L V6	8GMXT03.6151	5	
GM	2008	Chevrolet	C1500 Silverado	5.3L V8	8GMXT05.3373	5	FFV
Toyota	2008	Toyota	Corolla	1.8L I4	8TYXV01.8BEA	5	
Toyota	2008	Toyota	Camry	2.4L I4	8TYXV02.4BEA	5	
Toyota	2008	Toyota	Sienna	3.5L V6	8TYXT03.5BEM	5	
Toyota	2008	Toyota	Tundra	4.0L V6	8TYXT04.0AES	5	
Ford	2008	Ford	Focus	2.0L I4	8FMXV02.0VD4	4	
Ford	2008	Ford	Taurus	3.5L V6	8FMXV03.5VEP	5	
Ford	2008	Ford	Explorer	4.0L V6	8FMXT04.03DB	4	
Ford	2008	Ford	F150	5.4L V8	8FMXT05.44HF	8	FFV
Chrysler	2008	Dodge	Caliber	2.4L I4	8CRXB02.4MEO	5	
Chrysler	2008	Dodge	Caravan	3.3L V6	8CRXT03.3NEP	8	FFV
Chrysler	2008	Jeep	Liberty	3.7L V6	8CRXT03.7NE0	5	
Honda	2008	Honda	Civic	1.8L I4	8HNXV01.8LKR	5	
Honda	2008	Honda	Accord	2.4L I4	8HNXV02.4TKR	5	
Honda	2008	Honda	Odyssey	3.5L V6	8HNXT03.54KR	5	
Nissan	2008	Nissan	Altima	2.5L I4	8NSXV02.5G5A	5	

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3.4 Test Lubricants

Engine lubricants for this program have been provided by the EPA under WA 0-01.

3.5 Test Fuels

The three required test fuels, referred to as Fuels 17, 18, and 19, are already in SwRI's possession. Fuel procurement, analyses, storage, and handling for this project are covered under WAs 0-01 and 1-04.

3.6 Vehicle Preparation

All vehicle preparations were completed under WA 0-01.

3.7 Vehicle Testing

This work plan covers the testing of 19 vehicles with three test fuels. All vehicle soaks and tests will be conducted at a nominal temperature of 50°F. It is expected that intake air temperature and humidity during testing will be maintained at 50±2°F and 31±5 grains H_2O/lb dry air, respectively.

All vehicles will be tested on all test fuels using the California Unified Cycle (LA92). For this program, the LA92 will be conducted as a three-phase, cold-start test in a manner similar to the FTP. All tests on a given vehicle will be conducted using the same 48-inch single roll electric chassis dynamometer. It is expected that a single test site will be used for this entire program. The same driver will be used for all tests on a given vehicle; however, it may be necessary to use more than one driver in the program.

Prior to any emission test conducted in this program, the representative bulk oil temperature in the sump will be stabilized to within 50±3°F.

Each vehicle will be tested at least twice on a given fuel. After two tests have been completed and the acquired data have passed all quality control verifications, the need for a third test will be determined by following the variability criteria shown in Table 2. If the ratio of any of the criteria pollutants (CO_2, NO_X, NMHC) on a pair of tests for a given vehicle/fuel combination exceeds the levels shown in Table 2, a third test will be conducted. If a third test is needed, the EPA WAM will be notified (typically within 24 hours) and the summary data for the test pair in question will be provided. For budgeting purposes, this Work Plan assumes that 5 percent of all test pairs will require a third test. If the actual need to conduct a third test exceeds the 5-percent allocation, the project will incur additional costs.

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TABLE 2. VARIABILITY CRITERIA FOR TRIPLICATE TESTING

DILUTE GASEOUS EMISSION	CRITERIA FOR REQUIRING A THIRD TEST (COMPOSITE CYCLE EMISSIONS)
CO_2	Ratio of higher / lower > 1.04
NOx	Ratio of higher / lower > 1.81
NMHC	Ratio of higher / lower > 1.67

SwRI anticipates testing approximately eighteen (18) vehicles per week at 50°F. Testing will be conducted during one shift while vehicle preparation and preconditioning will be conducted during a second shift. This level of effort will require some overtime from core laboratory staff. An allocation for premium pay has been included in the attached budget.

3.7.1 Fuel Change and Test Execution Sequence

The fuel change and vehicle preconditioning sequence (Table 3) is given below:

TABLE 3. FUEL CHANGE AND TEST EXECUTION SEQUENCE

STEP	DESCRIPTION
1	Drain vehicle fuel completely via fuel rail whenever possible.
2	Turn vehicle ignition to RUN position for 30 seconds to allow controls to allow fuel level reading to stabilize. Confirm the return of fuel gauge reading to zero.
3	Fill fuel tank to 40% with next test fuel in sequence. Fill-up fuel must be less than 50°F.
4	Start vehicle and execute catalyst sulfur removal procedure described in Appendix C of CRC E-60 Program report. Engine oil temperature in the sump will be measured and recorded during the sulfur removal cycle.
5	Four vehicle coast downs from 70 to 30 mph shall be performed with the last two measured and monitored to establish tolerances for each vehicle for use in upcoming WA 1-03. A vehicle's average coastdown time from an individual fuel change sequence will be compared to the average of all coastdown times for that vehicle. If the individual run deviated from the overall average by more than ±5%, the vehicle will be checked for any obvious and gross source of change in the vehicle's mechanical friction. The results obtained during WAs 1-01 and 1-02 will be used to establish repeatability criteria to be used during WA 1-03.
6	Drain fuel and refill to 40% with test fuel. Fill-up fuel must be less than 50°F.
7	Soak vehicle at room temperature for at least 12 hours to allow fuel temperature to stabilize to the test temperature.
8	Move vehicle to test area without starting engine. Start vehicle and drive one 3-phase LA92 cycle. Allow vehicle to idle in park for two minutes before engine shutdown.
9	Move vehicle to soak area without starting or driving.
10	Park vehicle in soak area at 50°F for 12-36 hours. During the soak period, maintain the

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	nominal charge of the vehicle's battery using an appropriate charging device.
11	Move vehicle to test area without starting engine.
12	Perform LA92 cycle emissions test.
13	Park vehicle in soak area at 50°F for 12-36 hours. During the soak period, maintain the nominal charge of the vehicle's battery using an appropriate charging device.
14	Move vehicle to test area without driving.
15	Perform LA92 emissions test.
16	Determine whether third replicate is necessary, based on data variability criteria (see Table 2).
17	If a third replicate is required, repeat steps 13, 14 and 15.
18	If third replicate is not required, return to Step 1 and proceed with next fuel in test sequence.

3.7.2 Test Sequence

Following completion of WA 1-01, and prior to the start of testing under WA 1-02, it is expected that approximately three weeks will be needed to prepare for testing at 50°F. This schedule assumes successful installation and commissioning of the equipment necessary to conduct testing at 50°F. Unforeseen problems with the installation of the equipment needed to conduct testing at 50°F would result in additional costs and project delays that are not accounted for in this work plan.

The fuels will be tested in each vehicle in the following sequence: Fuel 17 (E0) followed by Fuel 18 (E10) and then Fuel 19 (E15).

Under WA 0-01 SwRI determined and verified sample flow rates that provide proportionality. Those same flow rates will be used for WA 1-02. The CVS blower will be kept on for approximately 20 minutes before the first emission test on a given day and continuously between emission tests to ensure tunnel stability.

SwRI will ensure consistent cooling fan placement and flow for each test vehicle on all the tests. The flow of air sweeping the vehicle in the test cell will be as consistent as is practical for all test conducted at 50°F.

SwRI has made allocations to conduct three (3) "blank" LA92 tests at regular intervals during this program. These tests will involve running the full test sequence drawing only background air into the sampling system. All sampling systems will be operated and measurements will include:

- Phase level THC, CH_4, CO, NO_X, CO_2, PM, ethanol by INNOVA, NO_2, VOCs (including aldehydes and alcohols)
- Continuous THC, NMHC, CO, NO_X, CO_2, N_2O, NH_3, and HCN

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3.7.3 Determination of Phase Level and Continuous Regulated Emissions

Phase-level (bag-by-bag) emissions to be determined and reported, and light-duty FTP weighting factors shall be used to calculate composite emissions. The following emissions rates will be determined:

- total hydrocarbons (THC)
- non-methane hydrocarbons (NMHC)
- non-methane organic gases (NMOG) as specified in Section 3.7.5 below
- oxides of nitrogen (NO_x)
- nitrogen dioxide (NO_2) will be determined by the difference of measured NO and NO_x values as well as by continuous mass spectroscopy
- carbon monoxide (CO)
- carbon dioxide (CO_2)
- particulate matter (PM)
- ethanol

Additionally, THC, NMHC, CO, CO_2 and NO_X, emissions will be determined on a continuous basis (1 Hz) from raw "modal" samples at the tailpipe position only. Although not required, these measurements will be made for all tests on order to maintain a consistent raw exhaust sample extraction rate.

The unweighted, integrated mass emissions by phase and for the entire test for the continuous THC, NMHC, CO, CO_2, NO_X, will be compared to the mass emission values measured by the mechanically integrated (bag) CVS samples. For only the unweighted, integrated mass emissions for the entire test, the following maximum deviations from the CVS measurements will be used as guidelines until appropriate criteria can be developed:

- THC: ±15%
- NMHC: ±15%
- CO: ±10%
- CO_2: ±5%
- NO_X: ±10%

The WA requests that a direct exhaust flow measurement device, such as a SEMTECH EFM from Sensors Inc., be used. However, SwRI determined during WA 0-01 that the EFMs as installed in SwRI's test site do not provide accurate exhaust flow measurement. This issue is being addressed separately under WA 1-06. In the mean time, exhaust flow will be calculated from the difference in dilution air flow and total dilute exhaust flow.

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Additional available data will be acquired at least 1 Hz from each vehicle's onboard diagnostic (OBD) system during all emissions tests using a DBK70 data acquisition system. The available data are expected to include:

- RPM
- Vehicle speed
- Engine load
- Short term fuel trim-bank 1
- Long term fuel trim-bank 1
- MIL status
- Absolute throttle position
- Engine coolant temperature
- Short term fuel trim-bank 2
- Long term fuel trim-bank 2
- PID $44 Fuel/air commanded equivalence ratio
- Alcohol fuel percent
- Manifold absolute pressure
- Spark advance
- PID $42 Control Module Voltage
- Air flow rate form mass air flow sensor

It should be noted that some of the parameters listed above may not be accessible for specific vehicles.

3.7.4 Speciation of Volatile Organic Compounds

Phase-level (bag-by-bag) speciated VOCs will include C_1-C_{12} hydrocarbons as well as light alcohols, aldehydes, and ketones. Sampling and analysis of C_2-C_{12} hydrocarbons will be conducted in a manner similar to CARB method 1002/1003, "Procedure for the Determination of C_2-C_{12} Hydrocarbons in Automotive Exhaust Samples by Gas Chromatography". Sampling and analysis of alcohols will be done using CARB method 1001, "Determination of Alcohols in Automotive Source Samples by Gas Chromatography". Sampling and analysis of carbonyl compounds will be conducted in a manner similar to CARB method 1004, "Determination of Aldehyde and Ketone compounds in Automotive Source Samples by High Performance Liquid Chromatography". Analysis of C_1 – C_4 HC samples will be done within one hour of completion of the emissions test. Subsequent analysis of the additional compounds of interest will be done within 4 hours of emission test completion. The time between sample collection and the start of C_1-C_4 HC analysis will be reported.

Sampling and analysis of light alcohols will be accomplished by bubbling exhaust through glass impingers containing deionized water and analyzing samples with a gas chromatograph. Analysis will include the following compounds: methanol, ethanol, isopropanol, and n-propanol.

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VOC speciation will be performed for all three test phases of the LA92 cycle, on all three test fuels, for a subset of 3 vehicles (Chevrolet Silverado, Toyota Sienna, and Honda Civic). This includes all repeat tests, and is outlined graphically in Table 4, below.

TABLE 4. VOC SPECIATION SUMMARY FOR 3 VEHICLES

LA92 Test Phase (bag)	LA92 Test Repeat		
	Test 1	Test 2	Test 3 (if needed)
Phase 1	C_1-C_{12} Speciation Light Alcohols Carbonyls	C_1-C_{12} Speciation Light Alcohols Carbonyls	C_1-C_{12} Speciation Light Alcohols Carbonyls
Phase 2	C_1-C_{12} Speciation Light Alcohols Carbonyls	C_1-C_{12} Speciation Light Alcohols Carbonyls	C1-C12 Speciation Light Alcohols Carbonyls
Phase 3	C_1-C_{12} Speciation Light Alcohols Carbonyls	C_1-C_{12} Speciation Light Alcohols Carbonyls	C1-C12 Speciation Light Alcohols Carbonyls

VOC speciation for the remaining 16 vehicles will only be conducted on samples from Phase 1 of the LA92 test for all three test fuels. This also includes all repeat tests and is outlined graphically in Table 5, below.

TABLE 5. VOC SPECIATION SUMMARY FOR 16 VEHICLES

LA92 Test Phase (bag)	LA92 Test Repeat		
	Test 1	Test 2	Test 3 (if needed)
Phase 1	C_1-C_{12} Speciation Light Alcohols Carbonyls	C_1-C_{12} Speciation Light Alcohols Carbonyls	C_1-C_{12} Speciation Light Alcohols Carbonyls
Phase 2	none	none	none
Phase 3	none	none	none

During the analysis of C_2-C_4 hydrocarbons, special consideration will be given to 1,3-butadiene. Because of the instability of 1,3-butadiene the analysis of C_2-C_4 hydrocarbon samples collected during Phase 1 of the test cycle shall be initiated within one hour of collection. The speciation of C_5-C_{12} hydrocarbon samples collected in Phase 1 of the test cycle will be completed within 4 hours of collection. The time between sample collection and the start of C_2-C_4 and C_5-C_{12} hydrocarbon analysis will be recorded. SwRI will make a good-faith effort to complete the analysis of C_2-C_4 and C_5-C_{12} background hydrocarbon samples on the day they are collected.

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Alcohol samples will be sealed and stored at a temperature below 40°F immediately following collection. A good-faith effort will be made to analyze these samples on the day they are collected, but no later than within six calendar days.

Samples of carbonyl compounds will be collected in cartridge type samplers. These samples will be extracted immediately following collection (within 15 minutes) and the extracts sealed and stored immediately at a temperature below 40°F. A good-faith effort will be made to analyze these extracts on the day they are collected, but no later than within three calendar days. This analysis will account for the presence of acrolein-x in the sample. The location of the acrolein-x peak in the HPLC chromatogram will be determined and, using the response factors derived from the calibration for acrolein, acrolein-x mass emissions will be quantified and reported.

Storage of alcohol and carbonyl samples will be segregated to prevent any cross-contamination of samples.

The following daily sequence will be used for vehicle testing:

- All vehicles requiring VOC sampling only during Phase 1 of the test cycle will be tested first.

- Any vehicle requiring VOC sampling during all three phases of the test cycle will be tested last. No more than one such vehicle will be tested per test day unless the total number of vehicles tested on that day and the timing of their tests will not compromise the time limit requirements for sample analyses.

The following daily sequence will be used for the analysis of VOC samples:

- VOC samples collected in Phase 1 of the test cycle will be analyzed first, in the sequence of vehicle tests.

- If a vehicle requiring VOC sampling during all three phases of the test cycle is tested, the Phase 1 sample will be analyzed first, followed immediately by the Phase 3 sample and finally by the Phase 2 sample.

- Background samples will be analyzed last, in the sequence of vehicle tests.

3.7.5 Determination of NMOG

The CARB procedure for calculating NMHC and NMOG will be followed. Phase-level NMOG will be calculated for all phases where the required measurements are available (i.e., NMHC, carbonyls, and light alcohol measurements are made). In cases where one or more components of the phase-level NMOG calculation is not measured (for example, when carbonyls are not measured in Phases 2 and 3 of some tests) phase-level NMOG mass emissions will by calculated by assuming the missing measurements are below method detection limits. These phase-

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level NMOG calculations will then be used to calculate composite weighted NMOG mass emission rates. In all cases, all measured phase-level NMOG components (i.e. each compound quantified) will be reported separately along with the associated FID response factors used in NMOG and NMHC determination.

3.7.6 Continuous Measurements of N_2O, NH_3 and HCN

Continuous and phase-integrated emissions of N_2O, NH_3 and HCN will be measured using Fourier Transform Infrared Spectroscopy (FTIR). Although these measurements are only required during the first test of each fuel/vehicle combination, they will be taken during all tests in order to maintain a consistent raw exhaust sample extraction rate.

4.0 REPORTING AND DELIVERABLES

4.1 Weekly Reports

SwRI will provide 30-60 minute telephone conference reports weekly that summarize progress to date. It is expected that this teleconference will cover WAs 1-01, 1-02, and 1-04 together.

The oral report will indicate progress achieved in the preceding week, technical issues encountered, solutions to issues (proposed or attempted), and projected activity in the following week. This report will include any potential issues or circumstances that arise causing any delays in the testing.

SwRI will provide on a weekly basis to the WAM a report summarizing hours and dollars expended for individual tasks. The goal of the report is to identify as early as possible if costs in hours and dollars are exceeding that which has been budgeted for the program.

4.2 Monthly Written Progress Reports

SwRI will provide monthly progress reports. Invoices will be provided every four weeks according to the existing contract. The monthly progress reports will include information from the most recent invoice. The reports will track percentages of hours used in each task and whether the project is on schedule. They will explain problems encountered including resolutions and indicate if the schedule or budget is affected.

4.3 Data Files

SwRI will submit data files to EPA via a secure FTP site using the same file format developed during WA 0-01.

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4.4 Mode of Delivery

SwRI will deliver one set of files to the EPA WAM at the USEPA National Vehicle and Fuel Emissions Laboratory at Ann Arbor, Michigan. Data contained in the MSOD formatted tables will be submitted via a secure method to be approved by the WAM. Under no circumstances will these files be delivered by insecure methods such as electronic mail attachments or First Class Mail.

4.5 Draft Final Report

SwRI will submit a draft final report to EPA within six weeks following the delivery of all test fuels required under this Work Assignment. The report will detail the work completed including any issues encountered and will include:

- Vehicle recruitment procedures
- Vehicle-related information, VIN, mileage, emission system descriptions, etc.
- Measurement methodologies and quality measures.
- Test completion diary for individual vehicles detailing any relevant information regarding completion of each test.
- Summaries of all data collected in this work assignment. Graphical displays summarizing the data by fuel type and other relevant breakdowns.
- Check lists used to control WA specific test protocols.

4.6 Final Report

SwRI will provide a final report incorporating EPA comments, within 30 days of receiving comments from EPA. The report will be in hard copy plus an agreed-upon electronic format such as Microsoft Word or Adobe portable document files (*.pdf).

5.0 STAFF ASSIGNMENTS

The SwRI Work Assignment Manager and Principal Investigator will be Kevin Whitney. Mr. Patrick Merritt will be the alternate Work Assignment Manager.

6.0 PROJECTED LABOR HOURS AND OTHER DIRECT COSTS

Based on our understanding of Work Assignment 1-02, we project the breakdown of employee utilization by labor category as detailed in Table 6. Estimates for other direct costs are shown in Table 7. Complete cost details for this effort are presented in the attached cost breakdown shown in Appendix A.

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TABLE 6. PROJECTED LABOR HOURS FOR WORK ASSIGNMENT 1-02

LABOR CATEGORY	NUMBER OF HOURS
PL4	Ex. 4 - CBI
PL3	
PL2	
PL1	
Senior Technical	
Technical	
Clerical	
Total	
Total Technical Hours	

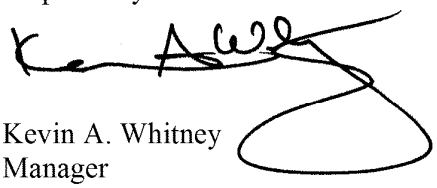
TABLE 7. PROJECTED OTHER DIRECT COSTS FOR WORK ASSIGNMENT 1-02

ITEM	PROJECTED OTHER DIRECT COSTS
Span gases	Ex. 4 - CBI
Nitrogen, zero air	
Sample filters	
Tedlar bags	
Exhaust pipe, flanges	
Swedgelock fittings	
Steel and teflon tubing	
Glassware	
HPLC and GC supplies	
Misc mechanical	
Misc electrical	
Misc chemical	
Monthly lease of 19 vehicles	
TOTAL	

7.0 SUMMARY

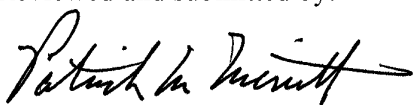
Southwest Research Institute has responded to Work Assignment 1-02. Should any questions of a technical nature arise, please contact Mr. Kevin Whitney at 210-522-5869 or Mr. Patrick Merritt at 210-522-5422. If there are questions regarding cost or contractual issues, please contact Ms. Sherry Twilligear at 210-522-3948. Thank you for this opportunity to be of service.

Prepared by:



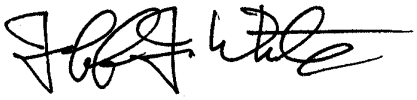
Kevin A. Whitney
Manager
Light-Duty Vehicle Emissions
Department of Emissions R&D

Reviewed and submitted by:



Patrick M. Merritt
Senior Research Scientist
Chemistry and Particle Science
Department of Emissions R&D

Approved:



Jeff J. White
Director
Department of Emissions R&D
Engine, Emissions and Vehicle Research

c: Mr. Carl Scarbro, EPA-AA
Ms. Constance Hart, WAM, EPA-AA
Mr. Rafal Sobotowski, Alternate WAM, EPA-AA
Mr. Carl Fulper, EPA-AA
Ms. Sherry Twilligear, SwRI Contracts

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APPENDIX A

COST DETAIL FOR WORK ASSIGNMENT 1-02

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